

## **Exhibit 1**

**Expert Witness Report**

**of**

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## Executive Summary

This report presents analysis of the admissions process to New York City's eight testing specialized high schools following a series of policy revisions fully implemented in 2020. It reaches the following conclusions:

- The announced changes to the Discovery program in 2018 – expanding the program to 20% of available seats in specialized high schools by 2020, and restricting eligibility to disadvantaged students attending schools with a high Economic Need Index (ENI) – were accompanied by an unannounced change: a significant revision to the ENI that added dozens of schools to the eligible list.
- The newly eligible schools were disproportionately Asian and non-white.
- Had these revisions to ENI not occurred, and if student behavior during the 2019/20 specialized high school admission process remained unchanged, the announced Discovery program changes would have lowered the representation of Asian students at specialized high schools by 3.6 percentage points.
- Had these revisions to ENI not occurred, and if student behavior during the 2019/20 specialized high school admission process remained unchanged, the announced Discovery program changes would also have lowered the representation of White students at specialized high schools by 3.6 percentage points.
- On the basis of student behavior observed in the 2019/20 specialized high school admission process, the revisions to ENI offset the effect of policy changes on the representation of Asian students, while having almost no impact on the representation of White students.
- On the basis of student behavior observed in the 2019/20 specialized high school admission process, the cumulative impact of the Discovery expansion, the restriction of eligibility to high-ENI schools, and revision of the ENI was to slightly increase the representation of Asian students in the specialized high schools as a whole.
- The revision of the ENI effectively shifted the negative impact of expanding the Discovery program and restricting it to high-ENI schools away from Asian students and toward White students.
- Although the three changes, together, resulted in an algorithm that did not reduce the proportion of Asian students offered admission to any specialized high school relative to the 2018 algorithm, their implementation associates with a series of behavioral changes among Asian takers of the Specialized High School Admissions Test (SHSAT).
- Each of the observed behavioral changes – a reduced tendency to list Stuyvesant High School as a first choice, a tendency to list fewer choices overall, and lower SHSAT scores – would have reduced the likelihood of admission regardless of policy change.
- Each of the findings above regarding the impact of the Discovery expansion assumes that the expansion did not affect test taking or school ranking behavior. The presence of observed behavioral changes directly challenges that assumption.
- Each of the observed behavioral changes can be explained as a consequence of discouragement, or an acknowledgment that official policy was about to make it more

difficult for Asian students to gain admission to specialized high schools. Any alternate explanation for why students changed their behavior would need to explain why the changes occurred only following the announced changes to the Discovery program and were only observed among Asian students.

- Straightforward calculations indicate that the behavioral changes exhibited by Asian students resulted in approximately 96 admission slots, or 1.7% of the total, being awarded to applicants of other races in 2019/20.

### **Specialized High School Admissions Prior to the Discovery Expansion**

The New York City Department of Education has administered some sort of admissions exam for specialized high schools since the 1930s. In the years leading up to 2018, the vast majority of seats in eight specialized high schools were administered on the basis of a standardized test, the Specialized High School Admissions Test (SHSAT). Seats were allocated according to a simple algorithm. Test-takers were asked to provide a ranked list of preferences for admission. The algorithm begins by taking those students with the highest test scores and assigning them their first-choice schools. It continues by considering students with the next highest scores, assigning them their first choice if it is still available. If a first choice is not available, the student's second choice is assigned so long as space is available, and so forth. The process continues until all spaces have been allocated at all high schools.

A certain number of seats in each specialized high school were reserved for allocation using a separate process, involving the Discovery program. This process targets students who scored below the lowest test score eligible to receive an offer through the regular admissions process, and who meet at least one criterion for being individually disadvantaged: residing in a low-income household, living in temporary housing, or being classified as an English Language Learner who moved to New York City within the past four years. Discovery seats are allocated via a parallel algorithm, starting with the eligible students with the highest test scores, granting them their first choice high school, and then continuing until the available slots at all eight schools have been filled.

Note that the Discovery program introduces concerns regarding vertical equity. Imagine two students who both meet the disadvantage criterion, and who both list Stuyvesant as their top choice school. Vertical equity would suggest that the applicant with a higher SHSAT score should be a higher priority for admission to Stuyvesant, given that both satisfy the disadvantage criterion. In hundreds of cases each year, however, the higher-scoring student may obtain a score high enough to qualify for a seat in one of the eight specialized high schools but not high enough for Stuyvesant – the most selective of the eight. The Discovery program is not designed to target the disadvantaged students who are just outside the range of acceptable scores for Stuyvesant to provide them access. It is designed to target disadvantaged students who are just outside the range of acceptable scores for any of the eight specialized high schools. As a consequence, the lower-scoring student may be admitted to Stuyvesant (through the Discovery program) while the higher-scoring student is not.

These are not marginal concerns. In the cohort of students who took the SHSAT in 2017/18, 738 disadvantaged students who ranked Stuyvesant as their top choice were denied admission to Stuyvesant while disadvantaged students who received lower scores were admitted via the Discovery program.

## The 2018 Discovery Expansion

In 2018, the New York City Department of Education introduced a change to the Specialized High School Admission process that involved two basic components:

- The proportion of seats reserved for the Discovery program increased in all eight schools.
- Eligibility for the Discovery program would no longer be a function of individual disadvantage, but a combination of individual disadvantage and school-level disadvantage. Specifically, only students attending schools with a city-calculated Economic Need Index (ENI) of 60 or above would be eligible.

The Economic Need Index (ENI), as the Department of Education notes in its Demographic Snapshot (dated July 23, 2020), “estimates the percentage of students facing economic hardship” in each school. It is unique to New York City, and of relatively recent construction, being first computed in 2014/15. The Department of Education chose to use this measure rather than a much more common means of estimating the percentage of students facing economic hardship in a school – the percent of students qualifying for free or reduced price lunch, a federal subsidy program where eligibility is based on family income.

The Department of Education publishes a second estimate of the percentage of students facing economic hardship, based primarily on the percent of students eligible for free or reduced-price lunch. As of 2016/17, these two measures were not perfectly correlated – meaning that some schools ranked highly on one measure might not rank highly on the other. Table 1 presents a statistical analysis describing how the ENI relates to percent in poverty and two measures of school racial composition: the percent of students identified as Asian or White.

Table 1: The Economic Need Index, Poverty, and Race

A 1% increase in the following measures	Predicts this change in ENI:
Percent of students in poverty	0.5% increase
Percent Asian students	0.3% decrease
Percent White students	0.3% decrease
Note: students of races other than Asian and White are the default category in the underlying regression model. All statistical effects have less than a 1 in 1,000 probability of occurring by chance.	

As expected, ENI tends to increase with the percent of students in poverty. For schools with similar poverty rates, however, the ENI tends to be significantly lower in schools serving a higher proportion of White or Asian students. Relative to a school where no students are identified as White or Asian, a school *with an identical poverty rate* where 50% of the student body represented one of those two racial groups would be predicted to have an ENI 15 points lower, on a 100 point scale. The 2016/17 ENI tended to downplay economic hardship in schools serving a high proportion of Asian and White students, relative to poverty rates as reported by the DOE. In the 23 majority-Asian schools serving 8<sup>th</sup> graders in 2016/17, the average DOE-

reported poverty rate exceeded the average ENI by 20 percentage points. In the 598 schools without an Asian majority, the average poverty rate exceeded the average ENI by only 10 points.

Setting aside the decision to use ENI rather than a more straightforward measure of poverty, the choice of 60 as the eligibility cutoff on that scale is fundamentally arbitrary. There isn't any reason to think that a school with a 59 ENI is fundamentally different from one with a 61; there may be differences, but they will be subtle. Table 2 makes clear that as of 2016/17, the schools just below the eligibility cutoff were disadvantaged in many respects. The student poverty rate, according to the Department of Education's Demographic Snapshot, was 70.3% in schools with an ENI between 50 and 59.9. That is only slightly lower than the 74.6% poverty rate in schools with ENI between 60 and 69.9.

Table 2: Characteristics of NYC schools serving 8<sup>th</sup> graders in 2016/17, by 2016/17 ENI

ENI range	Number of schools	Percent Asian	Percent Black	Percent Hispanic	Percent White	Poverty rate
0-9%	2	16.5	2.5	9.5	63	9
10-19%	12	15	6.2	15	59.8	19
20-29%	33	20.1	10.2	18.1	48.5	37.6
30-39%	31	23	18.4	22.7	32.6	48.1
40-49%	50	22.3	33.3	24.6	16.2	68.7
50-59%	76	15.9	36.4	33	12.5	70.3
60-69%	117	9.3	44.4	33.8	10.8	74.6
70-79%	137	5.6	40.5	48.3	4.3	82.1
80-89%	155	2.2	34.8	60.3	1.8	88.2
90-99%	8	1.5	34.6	62.3	1.3	94

Table 2 also shows that the starkest contrast between schools with 2016/17 ENI in the 50s from those with an ENI in the 60s pertains to the proportion of Asian students. Relative to schools with an ENI in the 60s, those with an ENI in the 50s had 70% greater representation of Asian students, on average (the ratio of 15.9 to 9.3). By comparison, nearly seven in ten students in schools with ENI between 50 and 59.9 were Black or Hispanic, against nearly eight in ten among schools in the next higher ENI "bin."

This contrast is also present when looking at individually disadvantaged students. Table 3 documents that in 2017/18, the test-taking year in which the 2016/17 ENI would have been consulted had ENI been incorporated as a criterion for Discovery program eligibility, nearly two-thirds of disadvantaged students with above-average SHSAT scores attending middle schools with an ENI in the 50s were Asian. Had the ENI threshold been set at 50 rather than 60, an additional 330 disadvantaged Black and Hispanic students with above-average SHSAT scores would have attended Discovery program-eligible schools – along with 934 additional above-average scoring Asian students. The numbers suggest, based on the 2017/18 SHSAT data, that an ENI of 60 was a "tipping point." Set the threshold at that level or above, and the majority of

Discovery-eligible students would be either Black or Hispanic. Set the threshold below 60, and the majority of Discovery-eligible students would be Asian.

Accordingly, had the ENI-above-60 rule been in effect for the cohort of students taking the SHSAT in 2017/18, more than half of all disadvantaged test takers, or 7,912 students, would have been rendered ineligible for the Discovery program based on their school's ENI. As Table 4 shows, 51.8% of these disadvantaged students were Asian, whereas only 22% of disadvantaged students in high-ENI schools were Asian.

Table 3: Number of 2017/18 Individually Disadvantaged SHSAT-takers with scores over 400, by race and 2016/17 school ENI

ENI range	Asian	Black	Hispanic	Multi-Racial	Native American	Unknown	White
0-9%	6	0	1	1	0	0	1
10-19%	54	5	14	7	0	2	43
20-29%	375	19	53	7	1	3	105
30-39%	453	22	69	1	7	0	87
40-49%	764	119	100	3	14	3	134
50-59%	934	123	207	3	12	1	139
60-69%	477	166	201	1	5	0	101
70-79%	230	145	208	3	3	0	24
80-89%	87	65	192	2	4	0	15
90-99%	1	6	3	0	0	0	0

Table 4: Racial Composition of Disadvantaged SHSAT-takers in Schools Serving 8<sup>th</sup>-Grade Students in 2017/18

	Schools with 2016/17 ENI at or above 60%	Schools with 2016/17 ENI below 60%
Total number of disadvantaged SHSAT takers	7,689	7,912
Asian	22.0	51.8%
Black	30.2	15.0
Hispanic	40.9	18.2
Multi-Racial	0.3	0.5
Native American	1.2	1.4
Unknown	0	0.2
White	5.4	12.9

Note: Data sources are Demographic Snapshot and SHSAT test score file. This latter file includes data for all SHSAT takers citywide, including their scores, their ranked priority list of specialized high schools, and which if any school they were invited to attend.



Among students with above-average SHSAT scores (400 or greater) the disparity is nearly as stark: Asians comprised 66.4% of disadvantaged high-scoring students who would have been rendered ineligible by the ENI requirement, against 41% of disadvantaged high-scoring students in high-ENI schools. Looked at in a slightly different way, the ENI-above-60 restriction would have rendered 76.5% of high-scoring disadvantaged Asian students ineligible for the Discovery program in 2017/18. Among Black and Hispanic students, the proportion made ineligible for the Discovery program by the high-ENI restriction would have been 57.4%.

Had the ENI-above-60 restriction been implemented using the ENI values that were in effect for the 2017/18 test taking cohort, the consequence – as shown in simulations below – would have been a drop in the proportion of Asian students offered entry into the specialized high schools. There was, however, one additional less-publicized shift in administrative policy that would impact the admissions process in 2018/19 and 2019/20.

### The 2018 change in ENI

A school's Economic Need Index typically changes very little from year to year. It is based on the characteristics of the students served by the school, and in stable economic times such as those that prevailed from 2014 to the beginning of 2020 these characteristics are not subject to large year-to-year fluctuations. Between 2015/16 and 2016/17, the correlation in ENI, computed among 574 8<sup>th</sup> grade-serving public schools in continuous operation, was 99.2%. (A correlation coefficient of zero indicates no relationship between two variables; a correlation coefficient of 100% indicates that two variables are exactly the same.) There are almost no meaningful differences in a school's ENI between one year and the next.

As a measure of student disadvantage, the ENI should track changes in economic conditions. Between 2015/16 and 2016/17, the unweighted average ENI across all schools serving 8<sup>th</sup> grade in New York declined by 1.2 percentage points, from 66.3 to 65.1, consistent with the continuation of economic recovery through these years.

As Table 5 shows, the change in ENI between 2014/15 and 2015/16 was also a small 1.2 percentage point decrease, consistent with economic recovery citywide, and the correlation in ENI was 99.4%.

Table 5: Year-to-year changes in the Economic Need Index (ENI) for schools serving 8<sup>th</sup> graders citywide

Time Interval	Change in unweighted average	Correlation
2014/15 to 2016/17	-1.20%	0.994
2015/16 to 2016/17	-1.20%	0.992
<b>2016/17 to 2017/18</b>	<b>10.50%</b>	<b>0.968</b>
2017/18 to 2018/19	-0.30%	0.994
2018/19 to 2019/20	1.00%	0.994

As also shown by Table 5, coincident with the 2018 introduction of an ENI over 60% as a condition for eligibility for the Discovery program, the ENI used for purposes of identifying eligible schools shifted dramatically. Following two years of slow but steady downward movement, the unweighted average ENI for schools serving 8<sup>th</sup> graders jumped by 10.5 percentage points, from 65.1 to 75.6. One might expect a dramatic shift in ENI if the economy were to violently enter a severe recession, as during the coronavirus pandemic of 2020, but there is no clear precipitating event between the 2016/17 and 2017/18 school years. The correlation between years also dropped from above 99% to 96.8%.

In the most recent demographic snapshot (dated July 23, 2020), the Department of Education provides the following explanation for why ENI rose dramatically (cell A15 of the NOTES tab of the spreadsheet):

Before the start of the 2017-18 school year, the New York State Education Department implemented a new data matching process that refined the methods to identify families eligible for free lunch. This new matching system provides a more efficient and accurate process for matching students across a range of forms that families already complete. This new matching process yielded an increase in the number of students directly certified for free lunch (in other words, matched to another government program) and therefore increased the direct certification rate. As such, the increase in the percent of students in poverty and the Economic Need Index for the 2017-18 school year and later reflects this new matching process, which allows the City to better identify students eligible for free lunch.

The alleged formula for ENI is provided in cell A13 of the NOTES tab in the same spreadsheet:

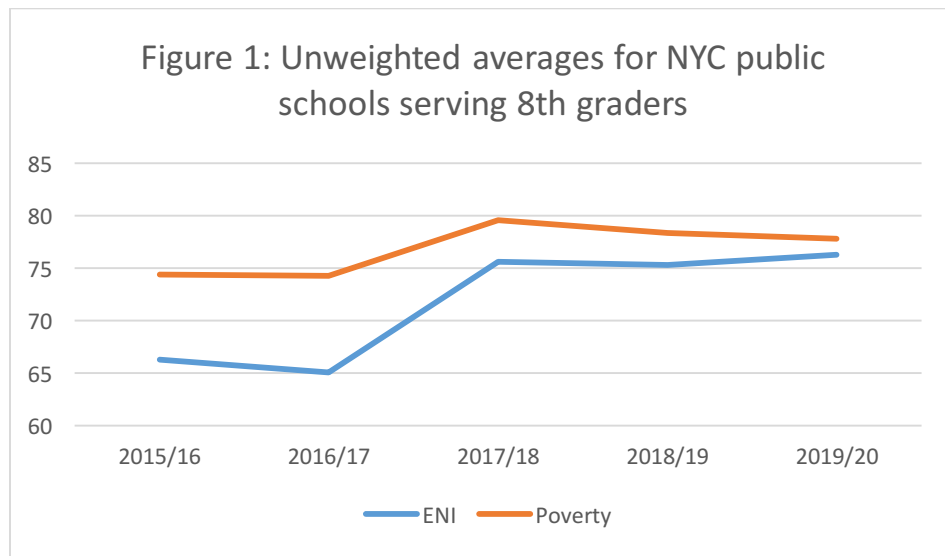
The student's Economic Need Value is 1.0 if:

- o The student is eligible for public assistance from the NYC Human Resources Administration (HRA);
- o The student lived in temporary housing in the past four years; or
- o The student is in high school, has a home language other than English, and entered the NYC DOE for the first time within the last four years.

\* Otherwise, the student's Economic Need Value is based on the percentage of families (with school-age children) in the student's census tract whose income is below the poverty level, as estimated by the American Community Survey 5-Year estimate (2016 ACS estimates were used in calculations for 2018-19 ENI). The student's Economic Need Value equals this percentage divided by 100.

Note that eligibility for free lunch does not appear anywhere in this description, creating an apparent disconnect between the description of how ENI is calculated and the explanation for the dramatic shift in ENI in 2017/18. It may be the case that better matching students to "another government program" established that roughly 10.5% of students were eligible for public assistance from the NYC Human Resources Administration yet not identified as eligible. However, I have not been given data that would support such a conclusion.

Figure 1 plots the unweighted average ENI for schools serving 8<sup>th</sup> graders over a five year period, along with the unweighted poverty rate as reported by the Demographic Snapshot. There is an uptick in the poverty rate in 2017/18, consistent with the Department of Education's argument that better data allowed more accurate labeling of students eligible for free and reduced lunch. The 5 percentage point increase in the poverty rate is less than half the observed increase in ENI, which again raises questions as to how ENI could be so sensitive to data that does not appear to factor into its formula.



While the Department of Education publicly claims that an improvement in data is responsible for the significant jump in ENI, a report prepared for the Department by researchers at RAND (Oppen, Johnston, Engberg, and Xenakis, 2019) provides the following information on the ENI (footnote 15, page 10):

The Economic Need Index is determined by the following calculation: (% of students in temporary housing) + (% of students eligible for public assistance \* 0.5) + (% of students eligible for free lunch \* 0.5)

*This formula is not the same as that listed in the demographic snapshot.* It introduces the possibility that the ENI did not rise in 2017/18 because of an improvement in data quality, but rather because the formula used to compute it changed. Notably, this alternate alleged formula does incorporate free lunch eligibility.

Regardless of whether the significant jump in ENI reflects a quantum leap in data quality or a change to the formula, it underscores that the index (like the cutoff of 60) is not determined by an independent third party, but is a measure of the Department of Education's or New York City's own creation. The DOE and the City have the authority to change the measure at will, and effectively did so.

The increase in ENI, whether attributable to revisions to the data or changes in the formula, meant that more schools qualified to send 8<sup>th</sup> graders on to the Discovery program. According to city demographic snapshots, there were 417 schools serving 8<sup>th</sup> graders with ENI values above 60 in 2016/17, out of 621 with a measured ENI. One year later, there were 515.

The increase in ENI between 2016/17 and 2017/18 was not evenly distributed across schools. As noted above, the year-to-year correlation across schools in continuous operation dropped to 96.8%. To be sure, this is still a high degree of correlation – high-poverty schools did not instantly transform into low-poverty schools, or vice versa. But ENI rose more in some schools than others. To some extent, this is a mechanical relationship – a school starting with an ENI of 91 or above could not possibly jump 10 points, as the maximum value is 100. But the pattern of ENI increases across schools is more complicated than a simple “raise all schools 10 points unless that puts them above 100.”

Statistical analysis, summarized in Table 6, shows that the unexplained increase in ENI between 2016/17 and 2017/18 was concentrated in schools serving a high proportion of Asian students and a low proportion of White students. Controlling for both factors simultaneously in a simple statistical model, a 50% Asian school would be predicted to have a  $5 \times 1.53\% = 7.6$  percentage point higher jump in ENI than a school serving no Asian students, holding the proportion of White students fixed. Raising the proportion of White students, by contrast, predicts a decline in ENI holding the proportion of Asian students fixed. These patterns are statistically significant, too prominent to be explained as a function of pure statistical chance or randomness. This does not necessarily prove that the intent of the ENI change was to make more Asian students eligible for the Discovery program, but it definitively shows that was the impact. The revisions to ENI substantially offset the pattern observed in Table 1, where schools serving a higher proportion of Asian students tended to be rated as lower ENI than other schools with equal poverty rates.

Table 6: Regression analysis examining the change in ENI between 2016/17 and 2017/18

A ten percentage point increase in:	Predicts this change in ENI:
Percent Asian	Increase by 1.53
Percent White	Decrease by 0.33
Note: Sample consists of 613 New York City public schools with ENI reported for both 2016/17 and 2017/18. These effects have at most 1 in 500 odds of occurring by chance. Data sources: Demographic Snapshot, SHSAT score file.	

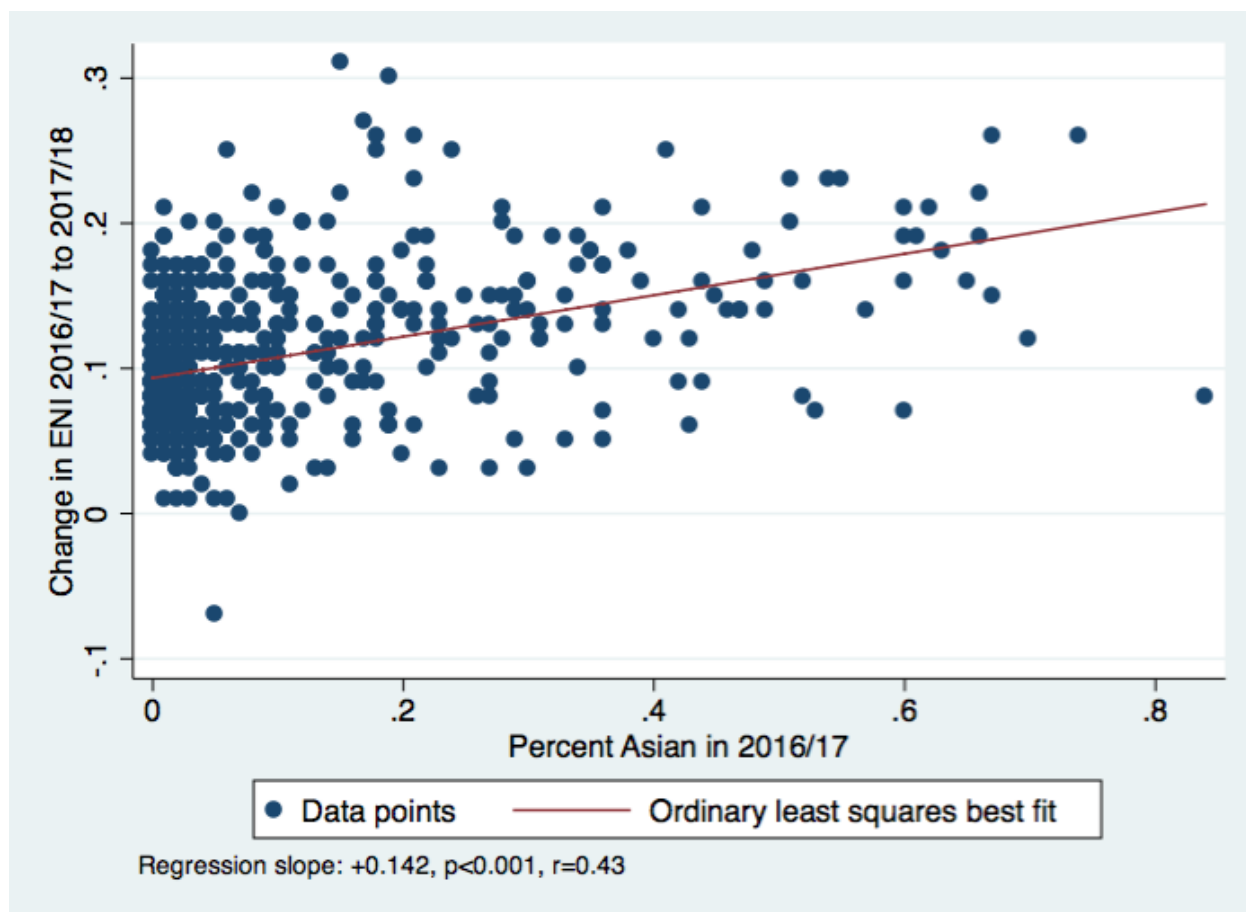
As another indicator of the demographic implications of expanding the roster of high-ENI schools, Table 7 shows that the 409 schools that qualified as high-ENI in both 2016/17 and 2017/18 were, on average, only 5.4% Asian. The 89 schools in continued operation that were not high-ENI in 2016/17 but attained that status in 2017/18 were, on average, 19.9% Asian. The complete set of schools that met the high-ENI criterion with the revised version of ENI is 7.9% Asian, less than half the citywide percentage as reported in the Demographic Snapshot (16.1% as of 2017/18).

Table 7: Racial Composition of Schools Meeting the High ENI standard as of 2017/18

	Schools that also met standard in 2016/17	Schools that did not meet standard in 2016/17	All schools (including those without an ENI for 2016/17)
Total number of schools	409	89	515
Asian	5.4%	19.9%	7.9%
Black	38.4%	35.4%	38.1%
Hispanic	49.6%	30.6%	46.3%
Other/unknown	3.9%	3.1%	1.9%
White	5.2%	11.3%	6.1%

Note: Data source is the Demographic Snapshot.

Figure 2 presents visual evidence of the tendency for disproportionately-Asian schools to post higher increases in ENI between 2016/17 and 2017/18. Each blue dot represents a New York City school serving 8<sup>th</sup> graders. The height of each dot shows how much ENI increased in that school, and the horizontal placement of each dot represents the percent Asian students in 2016/17. The upward sloping red line is the “best fit” of this relationship, using the statistical ordinary least squares algorithm. It confirms that the tendency for more-Asian schools to feature higher gains in ENI is far too large to be explained as an accident of statistical chance.



*Figure 2*

As shown in Table 5 above, after the unusual shift in ENI between 2016/17 and 2017/18, the index becomes stable once again, with correlation coefficients returning to the range between 99.3% and 99.4%.

Because the shift in ENI raised the average index by over 10 points, and the shift was concentrated in schools serving a high proportion of Asian students, the net impact of this change was to render a large number of disadvantaged Asian students eligible for the revised Discovery program. Simulations below will document that the proportion of Asian students among those offered seats at specialized high schools would have fallen considerably had the ENI not changed. Instead, this proportion grew, at the expense of students categorized as White or of unknown race.

### **Simulating the 2019/20 Admission Process Under Alternate Rules**

Data were provided on the test scores, school rankings, and middle schools of students who took the SHSAT in 2019/20, along with information on the school offered under the regular admissions process, if any, and the school offered through the Discovery program, if any. The same admissions data were provided for the four prior admission cycles.

For 2019/20, information on individual student disadvantage was provided only for students attending schools that met the high ENI standard. As the simulations require information on disadvantaged students attending other schools, individual-level disadvantage data were imputed using a multiple regression model. Data from the prior four admission years were used to estimate the probability that a student is disadvantaged on the basis of their race and middle school attended. These probabilities were then converted into imputed disadvantage via a series of weighted coin flips – meaning that a student with an imputed probability of disadvantage of 65% was randomly assigned to be disadvantaged 65% of the time. While this procedure cannot accurately identify individual students who were disadvantaged, it should more faithfully reproduce general patterns by race and middle school attended.

Having imputed disadvantage status, I performed three consecutive simulations under alternate sets of admission policies, using the actual 2019/20 SHSAT results. The results of these simulations are summarized in Table 8.

The first simulation follows an algorithm that closely matches the admission procedure used in 2017/18. In the first round, students are selected beginning with those posting the highest test scores and admitted to the first school on their ranked list with space available; quotas are set such that the number of students admitted will closely match the numbers assigned in this admissions round in 2017/18. A second round follows, awarding Discovery program seats to students with observed or imputed disadvantage in test score order, with the number of available slots calibrated to closely match the outcomes of 2017/18. This simulation answers

the question “what would the profile of admitted students look like if New York City had maintained its pre-2018 admission policy?”

The second simulation begins by accepting the results of the first round of 2019/20 admissions. It then proceeds with an expanded Discovery program that does not incorporate the high-ENI requirement, awarding seats to students with observed or imputed individual disadvantage until slots are filled at each of eight schools. This simulation answers the question, “what would the profile of admitted students look like if New York City had expanded the Discovery program without imposing the high-ENI requirement?”

The third simulation also accepts the first round of the 2019/20 admissions process. It expands Discovery and imposes a high-ENI requirement. However, it uses the Economic Need Index as computed in the 2016/17 school year. For those few middle schools that did not operate or were otherwise not assigned an ENI for 2016/17, an imputed ENI is generated by subtracting 10 percentage points from the 2019/20 value. This simulation answers the question, “what would the profile of admitted students look like if New York City had expanded the Discovery program and imposed the high-ENI requirement, but did not witness the significant increase in ENI skewed towards schools serving Asian students?”

Table 8 shows the racial composition of students actually offered either a seat in a specialized high school or access to the Discovery program for the 2019/20 admissions cycle, alongside the imputed racial composition that would have been observed had the three simulations’ alternate policies been followed.

Table 8: Racial Composition of Students Offered Specialized High School Admission Slots in 2019/20 Under Alternate Admissions Algorithms

	Actual Algorithm	2018 Algorithm	Expand Discovery, no ENI restriction	Expand Discovery, use 2016/17 ENI
Asian	53.0%	51.0%	51.4%	47.4%
Black	7.0	5.5	5.3	7.7
Hispanic	9.7	8.1	8.0	10.4
Multi-Racial	1.9	2.1	2.1	2.0
Native American	0.8	0.7	0.8	0.8
Unknown	5.1	6.8	6.9	9.5
White	22.4	25.8	25.6	22.2

Source: SHSAT test score file, author’s calculations.

At least three conclusions can be drawn from this data. First, compared to the 2018 algorithm, the three changes implemented between 2017/18 and 2019/20 – expansion of Discovery, restriction of Discovery eligibility to high-ENI schools, and the large uneven increase in ENI -- resulted in an admitted cohort with a higher percentage of Black, Hispanic, and Asian students.



The proportion of White students declined, as did the proportion of students of unknown race. There was very little change in the proportion of Multi-Racial or Native American students.

Second, had the ENI not shifted so dramatically after the 2016/17 academic year, the racial profile of students receiving offers would have looked very different. The percentage of Asian students would have declined rather than risen. The percentage of Black, Hispanic, and Unknown race would have increased. The percentage of White students would have been even lower than it was. The change in ENI values proves to be very consequential for admission outcomes in 2019/20.

Third, had New York City simply expanded the Discovery program without imposing any sort of ENI-based eligibility restriction, the racial composition of students given the opportunity to attend a specialized high school would have barely changed at all.

### *Simulations for individual schools*

Over five available years of admissions data, nearly three out of four test takers list one of three schools as their top choice: Stuyvesant, Bronx Science, and Brooklyn Tech. The same simulation methods outlined above can be used to examine the set of students that would have been offered admission, or a Discovery program invitation, to each of these three schools.

### Stuyvesant

Stuyvesant is the most selective of the eight specialized high schools. The average SHSAT score among accepted students, averaged over 5 years, is 592 – more than two standard deviations above the mean. The lowest SHSAT score resulting in a regular admissions offer to Stuyvesant, over 5 years, is 552 – just below the 95<sup>th</sup> percentile. Expansion of the Discovery Program made Stuyvesant even more selective – the cutoff for regular admission in 2019/20 was 566, 14 points higher than the cutoff in 2015/16.

Simulations, reported in Table 9, show that the Discovery expansion and restriction to high-ENI schools altered the racial composition of the cohort offered a chance to enroll at Stuyvesant. The proportion of Black and Hispanic students increased 2.2 and 2.3 percentage points, respectively. The proportion of Asian students declined by 0.7 percentage points; the proportion White and of Unknown race also declined.

The racial composition would have changed more substantially had ENI scores not increased after 2016/17. Simulations restricting eligibility to middle schools with a high ENI on that scale show that the proportion of Asian students would have dropped 7.4 percentage points rather than 0.7. Conversely, the proportion of White students would have dropped somewhat less and the number of students of Unknown race would have increased. If not for the revisions to ENI, Asian representation at Stuyvesant would have declined much more than it did.



Table 9: Racial Composition of Students Offered *Stuyvesant* High School Admission Slots in 2019/20 Under Alternate Admissions Algorithms

	Actual Algorithm	2018 Algorithm	Expand Discovery, no ENI restriction	Expand Discovery, use 2016/17 ENI
Asian	66.9	67.6	64.5	60.2
Black	4.1	1.9	2.9	4.3
Hispanic	5.4	3.1	4.5	6.5
Multi-Racial	2.8	3	3.1	3.1
Native American	1	0.9	1.1	1
Unknown	4.7	6.3	6.4	9.4
White	15.2	17.2	17.5	15.6

Source: SHSAT test score file, author's calculations.

Expansion of the Discovery program without imposing the high-ENI criterion would have also resulted in a decrease in the representation of Asian students relative to the 2018 admission process.

#### Bronx Science

Table 10 shows that the representation of Asian students at Bronx Science would have been 1.4 percentage points higher under the 2018 admission process. The revisions to the admissions process resulted in a higher representation of Black and Hispanic students, accompanied by a 1.4 percentage point drop in the proportion Asian. The shares of Native American, White, Multi-Racial, and students of unknown race also declined.

Table 10: Racial Composition of Students Offered *Bronx Science* High School Admission Slots in 2019/20 Under Alternate Admissions Algorithms

	Actual Algorithm	2018 Algorithm	Expand Discovery, no ENI restriction	Expand Discovery, use 2016/17 ENI
Asian	55.8	57.2	56.5	48.7
Black	6	3	3.4	5.4
Hispanic	11.5	7.2	8.8	12.9
Multi-Racial	1.6	2.4	1.6	1.7
Native American	1.2	1.6	1.3	1.3
Unknown	5.8	7.5	7.5	11
White	18	21.2	20.8	18.9

Source: SHSAT test score file, author's calculations.

As was the case at Stuyvesant, expanding the Discovery program without imposing a restriction to high-ENI schools would have had much less impact on the racial composition of Bronx Science. Using the 2016/17 ENI would have reduced the percent Asian much further, an 8.5 percentage point drop. The revisions to ENI raised Asian representation, and to a much lesser extent Black representation, at the expense of Hispanic and White students, as well as students of unknown race.

### Brooklyn Tech

Brooklyn Tech is both a common first choice school and significantly larger than the other specialized high schools. Since it admits many more students than either Bronx Science or Stuyvesant, the test score required for admission is typically much lower. Whereas students needed SHSAT scores of 566 and 531 for an offer to attend Stuyvesant or Bronx Science in 2020, respectively, the Brooklyn Tech cutoff was 507. Among the eight specialized high schools, only Brooklyn Latin posted a lower mean SHSAT score among students admitted via the standard pathway.

Table 11 shows that shifting from the 2018 admissions procedure to the 2020 version resulted in a higher proportion of Asian students, by 2.4 percentage points. The proportion of Black and Hispanic students also rose, while the shares of White and students of unknown race declined.

Table 11: Racial Composition of Students Offered *Brooklyn Tech* High School Admission Slots in 2019/20 Under Alternate Admissions Algorithms

	Actual Algorithm	2018 Algorithm	Expand Discovery, no ENI restriction	Expand Discovery, use 2016/17 ENI
Asian	50.1	47.7	47.8	45.2
Black	7.5	6.7	6.3	8.9
Hispanic	9.4	8.2	7.4	10.1
Multi-Racial	2	2	2.2	2
Native American	0.7	0.4	0.7	0.6
Unknown	4.7	6.1	5.9	7.8
White	25.7	28.9	29.8	25.4

Source: SHSAT test score file, author's calculations.

Once again, simulations show that the revisions to ENI after 2016/17 were more consequential to the racial composition of Brooklyn Tech than either the pure expansion of the Discovery program or the restriction of eligibility to students in high-ENI schools. Had the older ENI been in effect for the 2019/20 admissions cycle, the proportion of Asian students would have been 4.9 percentage points lower – and 2.5 percentage points lower than the 2018 admissions algorithm. Asian students are the only group whose representation at Brooklyn Tech was significantly increased by the revisions to ENI; they caused the proportion of Black and Hispanic

students to decline and a very slight (0.3 percentage point) increase in the share of White students.

#### The Remaining Specialized High Schools

Table 12 presents analogous simulation results for the other five specialized high schools. In all five cases, the simulations indicate that the shift from the 2018 to the 2020 admissions process resulted in a higher representation of Asian students, alongside a lower representation of White students. In two of the five high schools – Queens High School for the Sciences and Staten Island Tech – the representation of Asian students would have declined rather than increased if the City had continued to use the 2016/17 ENI. In all five high schools, the ENI revisions favored Asian students. At Queens High School for the Sciences, the 2020 admissions process actually results in lower representation of Black, Hispanic, and White students relative to the 2018 process.

#### *Summary*

The three changes to the admissions process described above – the expansion of the Discovery program, restriction of Discovery eligibility to high-ENI schools, and revisions to ENI after 2016/17 – slightly increased the representation of Asian students across all specialized schools as a group. These admissions process changes, however, decreased representation at the two most selective schools, Stuyvesant and Bronx Science, while increasing representation at less selective schools. The general increase in Asian representation at the specialized schools (although not the most selective schools) is attributable to the significant changes in ENI after 2016/17.

Table 12: Racial Composition of Students Offered High School Admission Slots in 2019/20 Under Alternate Admissions Algorithms

	Actual Algorithm	2018 Algorithm	Expand Discovery, no ENI restriction	Expand Discovery, use 2016/17 ENI
<i>Queens High School for the Sciences at York College</i>				
Asian	78.8	72.5	75.4	67.9
Black	5.1	7.6	5.5	9.2
Hispanic	6.6	7.6	9.1	7.1
Multi-Racial	0	0	0	0
Native American	0.5	0.5	0.5	1
Unknown	3	4.3	4.5	9.2
White	6	7.6	5	5.6
<i>Staten Island Tech</i>				
Asian	60.8	58.4	58.4	53.6
Black	1.7	0.2	0.7	3.9
Hispanic	4.3	3.2	3.6	6
Multi-Racial	0.5	0.9	0.7	0.5
Native American	0	0.2	0	0
Unknown	2.4	4.4	3.8	9.7
White	30.3	32.6	32.8	26.2
<i>Brooklyn Latin School</i>				
Asian	42.7	39.2	41.2	39.3
Black	11.6	10.3	9.7	11.8
Hispanic	12.5	12.7	11.2	13.3
Multi-Racial	1.6	1.7	2.1	1.7
Native American	1.1	0.7	0.9	1.1
Unknown	5.8	7.3	7.5	9.5
White	24.8	28.1	27.4	23.4
<i>High School of American Studies at Lehman College</i>				
Asian	21	15.4	21.1	20.2
Black	12.9	10.1	7.2	10.1
Hispanic	19.9	18.8	16	16.5
Multi-Racial	3.2	3.9	3.6	3.7
Native American	0.5	1	0.5	0.5
Unknown	10.8	13.9	13.9	15.4
White	31.7	37	37.6	33.5
<i>High School of Mathematics, Science and Engineering at City College</i>				
Asian	24.1	20.1	25.7	22.7
Black	13.9	8.8	8	35.1
Hispanic	20.3	18.1	14.8	17.8
Multi-Racial	2.1	1.5	2.1	1.7
Native American	0.4	0.5	0.8	0.4
Unknown	8.4	13.7	13.5	14.1
White	30.8	37.3	35	31

Source: SHSAT test score file, author's calculations.

### Student access to most-preferred schools

The analysis above asks whether changes to the admission process led to shifts in the racial composition of New York's specialized high schools. Another question of potential interest, given the availability of student preference rankings in the admissions data, is whether changes to the admission process led to any shifts in whether students were able to attend their most preferred school.

To study this question, I estimated statistical models to predict the likelihood that a student in a given year would be offered admission – whether by the regular process or Discovery – to the school they had listed as their highest preference. Across the five years of admissions data, between 10 and 12 percent of SHSAT takers receive an offer to their top choice school. The ordinary least squares regression models I estimated consider whether the likelihood of top-choice admission changed for Asian students relative to those of other races in 2018/2019, a transition year for Discovery expansion, or the first year of full implementation in 2019/20. Table 13 presents summary information derived from these regression models.

Table 13: Probability of a Student Receiving an Admissions Offer to their Top Choice School

	Model 1	Model 2	Model 3
Baseline (2016)	9.0%	9.0%	9.0%
For 2017 add/subtract	-0.8	-0.8*	-0.6*
For 2018 add/subtract	-2.7*	-2.7*	-1.9*
For 2019 add/subtract	-2.2	-2.2*	-1.3*
For 2020 add/subtract	-1.9	-1.9*	-1.1*
If Student is Asian:			
For 2016-18 add/subtract	9.4*	-2.1*	-2.7*
For 2019 add/subtract	11.1*	0.7	-0.4
For 2020 add/subtract	10.9*	-0.1	-1.0
SHSAT controls	None	Linear	Fixed Effect

Note: Statistics marked with \* have no more than 1 in 1,000 odds of occurring by chance.

Linear controls for SHSAT restrict comparisons to students with similar test scores. Fixed effect controls for SHSAT restrict comparisons to students with identical test scores.

The simplest model (Model 1) effectively shows how the likelihood of a student being offered their top choice school evolved over time, and separately by race. Between 2015/16 and 2017/18, Asian students were twice as likely to be offered their first choice relative to students of any other race. As subsequent models will show, this is because Asian students, on average, score higher on the SHSAT than students of other races. While students of other races were slightly less likely to be offered their top-choice school after the Discovery expansion, relative to the baseline year of 2015/16, Asian students saw increases in this probability, of 1.7 percentage points in 2018/19 and 1.5 percentage points in 2019/20.

The second and third models introduce statistical controls for SHSAT scores. The second model (Model 2) asks whether Asian students were more likely to receive an offer to their top choice schools than other-race students with similar SHSAT scores. The third (Model 3) asks whether this racial difference is observed among students with identical SHSAT scores.

Both Model 2 and Model 3 show that compared to other students with similar or identical SHSAT scores, Asian students were *less* likely to be admitted to their top choice school in the years through 2017/18, by about two percentage points. As we will observe below, this can largely be explained by a tendency to list Stuyvesant, the most selective specialized high school, as a first choice. Both models indicate that this Asian disadvantage effectively disappeared in 2018/19 and 2019/20. Again, as we will see below, this shift can be explained by a change in test-taker behavior.

### **The Expansion of the Discovery program and the Behavior of Test-Takers**

The expansion of the Discovery program was announced publicly, and its motivation was made very clear. As a June 2, 2018 article in the *New York Times* describing the proposed changes writes in its second paragraph:

Black and Hispanic students, who make up 67 percent of the public school population, are grossly underrepresented at the specialized high schools, which include Stuyvesant High School and the Bronx High School of Science.

With the city expressly embracing a policy intended to increase representation of Black and Hispanic students at specialized high schools, did Asian test-takers and their families react to the implicit message that their group was over-represented and might face reduced chances of admission to these elite schools?

Test-taker behavior matters along multiple dimensions. Discouraged students might devote less time to their preparations for the SHSAT. If so, and their test scores declined as a result, their likelihood of admission to a specialized school might suffer even if the actual impact of the policy change were minimal. Discouraged students might also lower their expectations in a manner that limits their admissions possibilities. For example, as Stuyvesant is the most selective high school, students will generally not be offered admission unless they list it as their first choice. Logically, a student who aspires to attend Stuyvesant should list it at their top choice – ranking it in any position other than first is tantamount to a guarantee that they will not attend. But a discouraged student might infer, rightly or wrongly, that their chance of being admitted to Stuyvesant has been diminished by policy change. If this discouragement leads them to refrain from listing Stuyvesant as their top choice, that effectively guarantees that they will never attend. Discouragement, in other words, might lead to self-fulfilling prophecies.

The simulation results summarized above suggest that the revisions to the admissions policy did not reduce the representation of Asian students at specialized high schools as a whole. But

these simulations operate with the test scores and high school rankings test takers provided. If these factors have been impacted by discouragement, the simulation will offer a misleading portrait of what the racial composition of specialized high schools might have been absent the policy change.

Table 14 documents a shift in the behavior of Asian applicants coincident with the expansion of Discovery and restriction to high-ENI schools. In the admission cycles of 2015/16, 2016/17, and 2017/18, a very consistent proportion of Asian test-takers listed Stuyvesant as their top choice school: the proportion varies between 38.8% and 39.4%. This percentage drops to 37.3% in 2018/19 and still further to 36.6% in 2019/20. With over 8,000 Asian SHSAT test takers every year, the table suggests that roughly 150 to 250 decided against listing Stuyvesant as their top choice, thereby eliminating themselves from the pool of prospective applicants to Stuyvesant.

Table 14: Percent of Asian SHSAT-takers listing Stuyvesant as their top choice

Year	Percentage
2015/16	39.4%
2016/17	38.8
2017/18	39.4
2018/19	37.3
2019/20	36.6

This pattern of evident discouragement is unique to Asian students. Table 15 presents the results of statistical models testing for whether the shift in Asian students ranking is too large to be explained as a statistical fluke, and whether it is also observed among students of other races. The first model, comparing students regardless of SHSAT score, shows that in the 2019/20 application cycle in particular Asian students became 2.2 percentage points less likely to list Stuyvesant as their top choice, relative to the baseline behavior observed in early admission cycles and relative to students of all other races. This pattern has only a 1 in 1,000 chance of occurring randomly. The evident discouragement effect is roughly half the size in 2018/19, with a 1 in 7 chance of occurring by random chance.

The Asian discouragement effect shrinks slightly in magnitude when comparing students with identical SHSAT scores. It indicates that Asian students became 1.9 percentage points less likely to list Stuyvesant as their top choice, relative to students of other races, in 2019/20. This pattern has only a 1 in 250 chance of occurring randomly.

Beyond failing to rank Stuyvesant as their top choice, applicants can unilaterally reduce their chances of admission to specialized high schools by failing to include one or more on their ranked list. Between 2015/16 and 2017/18, between 45% and 46% of all Asian test takers listed all 8 specialized high schools in their personal preference list. By 2019/20, this proportion had fallen below 41%.

Table 15: Regression Analysis Examining the Probability of Selecting Stuyvesant as First Choice

	Model 1	Model 2 (SHSAT fixed effects)
Baseline Probability	22.0%	22.0%
Year 2016/17 adjustment	-0.3	0.1
Year 2017/18 adjustment	0.4	0.1
Year 2018/19 adjustment	-0.8	-1.5*
Year 2019/20 adjustment	-0.3	-0.9
Base Asian adjustment	17.1*	10.5*
Change to Asian adjustment for 2019	-1.0	-0.5
Change to Asian adjustment for 2020	-2.2*	-1.9*

Note: Statistics marked \* have no more than 1 in 100 odds of occurring by chance.

Table 16 shows the results of statistical models comparable to those in Table 14, studying whether the change in school ranking behavior by Asian students is too large to be explained by statistical chance and distinct from patterns among students of other races. Whether comparing all students regardless of SHSAT scores or students with identical SHSAT scores, the models show that in the early years Asian students tended to rank more schools than students of other races. Comparing a set of 10 randomly selected Asian applicants to a set of 10 randomly selected applicants of other races, the Asian students would be expected to have, collectively, three to four additional schools on their lists. The odds of such a difference occurring by chance are less than 1 in 1000.

Table 16: Regression Analysis Examining the Number of High Schools Ranked

	Model 1	Model 2 (SHSAT fixed effects)
Baseline Mean	5.5	5.5
Year 2016/17 adjustment	-0.32*	-0.25*
Year 2017/18 adjustment	-0.19*	-0.19*
Year 2018/19 adjustment	-0.07*	-0.09*
Year 2019/20 adjustment	-0.04	-0.05
Base Asian adjustment	0.35*	0.39*
Change to Asian adjustment for 2019	-0.14*	-0.11*
Change to Asian adjustment for 2020	-0.37*	-0.33*

Note: Statistics marked \* have no more than 1 in 100 odds of occurring by chance.

The behavior of Asian applicants changed relative to applicants of all other races in 2018/19 and 2019/20. The tendency to rank more schools than students of other races disappeared. The observed changes in behavior are too large to be explained as statistical flukes, with the odds of occurring by chance no greater than 1 in 250 in any model presented.



Standardized test scores can be influenced by preparation efforts. The Department of Education provides practice questions for test-takers; both non-profit and for-profit organizations offer a variety of additional preparation services. Beyond discouragement effects, the Discovery program introduces incentives for students to earn lower test scores. In the 2019/20 academic year, students earning a 494 on the SHSAT were offered seats in only two specialized high schools: Brooklyn Tech and Brooklyn Latin. Students earning a 493, if eligible for the Discovery program, were offered the chance to enroll in six different schools, with one-third being offered a chance at attending Stuyvesant.

Should students ease up on their preparations, or even intentionally lower their scores, in order to take advantage of the Discovery program? It's a risky strategy. While it is known *ex post* that Discovery-eligible students would have more options with a 493 than a 494 in 2019/20, the exact location of that cutoff was not known *ex ante*. A student whose reduced effort resulted in earning a 494 rather than a 493 would see only a reduction in their options, as would a student who earned a 487 rather than a 493. Nonetheless, by adopting a policy that offers, in certain circumstances, better alternatives to lower-scoring students, the Department of Education may lead students to reduce their test preparation efforts in a manner that might backfire.

Table 17 presents the results of statistical models that assess whether the SHSAT scores of Asian students declined, relative to students of other races, following the expansion of the Discovery program and eligibility restriction to high-ENI schools. These results cannot distinguish whether the patterns observed can be attributed to strategic behavior or discouragement. Nonetheless, the pattern is clear: the SHSAT scores of Asian students declined by 3-5 points in 2018/19 and 2019/20, relative to students of other races. This pattern occurs in a model comparing all students citywide, and a second comparing students only to other students attending the same middle school. The results are too large to be explained as a consequence of statistical chance, with at most 1 in 30 odds of occurring at random.

Table 17: Regression Analysis Examining SHSAT scores

	Model 1	Model 2 (MS fixed effects)
Baseline Mean	376	376
Year 2016/17 adjustment	-0.11	-0.3
Year 2017/18 adjustment	5.6*	3.8*
Year 2018/19 adjustment	7.6*	6.0*
Year 2019/20 adjustment	6.0*	5.6*
Base Asian adjustment	56.3*	38.2*
Change to Asian adjustment for 2019	-5.2*	-3.3*
Change to Asian adjustment for 2020	-2.8	-3.9*

Note: Statistics marked \* have no more than 1 in 100 odds of occurring by chance.

Each of the three behavioral shifts documented above – a reduced tendency to list Stuyvesant as a top choice, a tendency to rank fewer schools, and lower SHSAT scores – could logically be explained as a direct response to the Department of Education's publicly stated intent to

reserve a higher proportion of seats for non-Asian students at specialized high schools. Moreover, each of these behavioral shifts reduces the chance of receiving an offer to a specialized high school, even in the event that the impact of the policy does not match intent. A statistical model based on admissions data shows that students reduce their chance of receiving any admission offer, including via the Discovery program, by 4 percentage points when they fail to list Stuyvesant as their top choice, that they reduce their chances by 0.4 percentage points for every specialized high school left off their ranked list, and that their chances decline by 0.3 percentage points for every one-point drop in SHSAT score. Multiplying these effects by the magnitude of the behavioral changes shown above suggests that Asian students on average saw their admission chances shrink by 1.1 percentage points as a consequence of observed behavioral shifts – implying that these changes resulted in 96 Asian students being denied an offer to attend a specialized high school in 2019/20, an effect impossible to capture in the simulation results above. This amounts to 1.7% of admission offers actually extended.

The analysis above suggests that the impact on Asian students of the very prominent expansion of the Discovery program, and eligibility restriction to high-ENI schools, was effectively canceled out by the less widely publicized revision to ENI scores after 2016/17. These simulations take student test performance and high school rankings of students as given. The results here suggest that this is a problematic assumption: that the test performance and high school rankings of Asian students were in fact altered by the policy changes of 2018, in ways that would end up reducing their chances of admission whether or not the policy changes were carried out.

Specialized high school admission is a function of policies adopted by the Department of Education and student behavior. The racial composition of these schools can be altered by policy, or it can be altered via altering behavior. The evidence presented here is consistent with the conclusion that the Department of Education, by adopting a stance declaring that the representation of Asian students at specialized high schools was too high, had a chilling effect on Asian students that negatively affected their chances of admission even if, in the end, policy changes did not have that direct effect.

## Addenda

### ***List of Publications since 2010***

Vigdor, J.L. "Seattle's Tarnished Dream." *City Journal* July 21, 2020.

Vigdor, J.L. Review of *Bottlenecks: A New Theory of Equal Opportunity*, Joseph Fishkin, Oxford University Press, 2014. *American Political Thought*, v.7 n.1 (Winter 2018) pp.177-80p

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### ***Legal testimony and depositions since 2016***

None

### ***Compensation in this case***

I received a flat fee of \$40,000, inclusive of any and all expenses, to cover the following activities:

1. Review and analysis of facts and information.
2. Written expert report.
3. One deposition.

Any activity beyond the items listed above will be compensated at the rate of \$450/hour.